WE CLAIM:

1. A high efficiency switching power amplifier for amplifying a high frequency input signal having at least one fundamental frequency, and adapted to drive a load, comprising:

(a) a high-speed active device that includes

a switching component that operates substantially as a switch and

a parasitic capacitance, C_{out}, in parallel with the switching component; and

a hybrid class E/F load network connected to the active device.

2. The amplifier of claim 1, wherein the network is configured to present to the switching component, at all harmonic frequencies substantially present in at least one of the voltage and current waveforms of the active device,

(i) a substantially inductive load at each fundamental frequency;

(ii) a substantially open circuit at a predetermined number, N_E, of even harmonic overtones for each fundamental frequency up to an N^{th} harmonic,

(iii) a substantially short circuit at a predetermined number, N_O, of odd harmonic overtones for each fundamental frequency up to an N^{th} harmonic, and

(iv) a substantially capacitive impedance load at the remaining harmonic overtones, up to an N^{th} harmonic,

where $N \geq 3$ and $1 \leq N_E + N_O \leq N-2$.

3. The amplifier of claim 2, wherein if $N_E = 1$, then $N_O > 0$.

4. The amplifier of claim 2, wherein the load network includes a two port filter network having an input port and an output port, the input port being connected to the active device and the output port being connected to the load.

5. The switching power amplifier of claim 1, wherein the hybrid class E/F load network is configured to present to the switching component

(i) a substantially inductive load at the fundamental frequency of operation,

(ii) a substantially open circuit at a predetermined number of even harmonic overtones of the fundamental frequency,

(iii) a substantially short circuit at a predetermined number of odd harmonic overtones of the fundamental frequency, and

(iv) a substantially capacitive impedance load at the remaining harmonic overtones.

6. A high efficiency switching power amplifier for amplifying a high frequency input signal having at least one fundamental frequency, f_0, and adapted to drive a load, comprising:

(a) a high-speed active device that includes

a switching component that operates substantially as a switch and

a parasitic capacitance, C_{out}, in parallel with the switching component; and

(b) a hybrid class E/F load network connected to the active device, wherein the network is configured to present to the switching component, at all harmonic frequencies that are substantially present in at least one of the voltage and current waveforms of the active device,

(i) a substantially inductive load at each fundamental frequency of operation that results in substantially zero-voltage-switching (ZVS) operation of the active device,

(ii) impedances substantially larger in magnitude than $1/(2\pi f C_S)$ a at a predetermined number, N_E, of even harmonic overtones of each fundamental frequency,

(iii) impedances substantially smaller in magnitude than $1/(2\pi f C_S)$ at a predetermined number, N_O, of odd harmonic overtones of each fundamental frequency, and

(iv) an impedance substantially equal to $1/j\omega C_S$ at the remaining harmonic overtones of each fundamental frequency,

wherein

$C_s = C_{out} + C_{added}$, where $C_{added} \geq 0$, and

$N_E \geq 0$, $N_O \geq 0$, and the total number of tuned harmonic overtones, $N_E + N_O$, is at least one and less than the total number of harmonic frequencies substantially present in the active device's at least one of voltage and current waveforms.

7. A high efficiency switching power amplifier for amplifying a high frequency input signal having at least one fundamental frequency and adapted to drive a load, comprising:

(a) a first high-speed active device that includes

a switching component that operates substantially as a switch and

a parasitic capacitance, C_{out1}, in parallel with the switching component,

(b) a second high-speed active device that includes

a switching component that operates substantially as a switch and

a parasitic capacitance, C_{out2}, in parallel with the switching component, and

(c) a hybrid three-port class E/F load network having

(i) a first port connected to the first active device,

(ii) a second port connected to the second active device, and

(iii) a third port connected to the load,

such that when the first and second active devices are driven in a push-pull configuration, the network presents to the switching components of the active devices an effective input impedance that provides

(i) a substantially inductive load in series with the substantially resistive load at all fundamental frequencies;

(ii) a substantially open circuit at one or more even harmonics for each fundamental frequency up to an N^{th} harmonic,

(iii) a substantially short circuit at one or more odd harmonics for each fundamental frequency up to an N^{th} harmonic, and

(iv) a substantially capacitive impedance load at the remaining harmonic overtones, up to an N^{th} harmonic.

8. The amplifier of claim 7, further including a transformer connected to the outputs of the two active devices and the load such that the load is dc isolated from the outputs of the two active devices via the transformer.

9. The amplifier of claim 1, wherein the load network is configured to provide wideband tuning of an input signal having a fundamental frequency range from f_1 to f_2 such that $f_2 \geq f \geq f_1$, where $f_2 < 3f_1$.

10. The amplifier of claim 1, wherein the network is configured to present to the switching component, at all harmonic frequencies substantially present in at least one of the voltage and current waveforms of the active device,

(i) a substantially inductive load at each fundamental frequency;

(ii) a substantially open circuit at the 2^{nd} harmonic, and

(iii) a substantially capacitive impedance load at the remaining harmonic overtones, up to an N^{th} harmonic,

where $N \geq 3$.

11. The amplifier of claim 1, wherein the network is configured to present to the switching component, at all harmonic frequencies substantially present in at least one of the voltage and current waveforms of the active device

(i) a substantially inductive load at each fundamental frequency;

(ii) a substantially short circuit at the 3rd harmonic, and

(iii) a substantially capacitive impedance load at the remaining harmonic overtones, up to an N^{th} harmonic,

where $N \geq 3$.

12. The amplifier of claim 1, wherein the network is configured to present to the switching component, at all harmonic frequencies substantially present in at least one of the voltage and current waveforms of the active device

(i) a substantially inductive load at each fundamental frequency;

(ii) a substantially short circuit at the 3rd harmonic,

(iii) a substantially open circuit at the 2nd harmonic, and

(iv) a substantially capacitive impedance load at the remaining harmonic overtones, up to an N^{th} harmonic,

where $N \geq 4$.

13. The amplifier of claim 1, wherein the network is configured to present to the switching component, at all harmonic frequencies substantially present in at least one of the voltage and current waveforms of the active device

(i) a substantially inductive load at each fundamental frequency;

(ii) a substantially open circuit at the 4th harmonic, and

(iii) a substantially capacitive impedance load at the remaining harmonic overtones, up to an N^{th} harmonic,

where $N \geq 4$.

14. The amplifier of claim 1, wherein the network is configured to present to the switching component, at all harmonic frequencies substantially present in at least one of the voltage and current waveforms of the active device

(i) a substantially inductive load at each fundamental frequency;

(ii) a substantially open circuit at the 2^{nd} and 4^{th} harmonics, and

(iii) a substantially capacitive impedance load at the remaining harmonic overtones, up to an N^{th} harmonic,

where $N \geq 4$.

15. The amplifier of claim 1, wherein the network is configured to present to the switching component, at all harmonic frequencies substantially present in at least one of the voltage and current waveforms of the active device

(i) a substantially inductive load at each fundamental frequency;

(ii) a substantially short circuit at the 3^{rd} harmonic,

(iii) a substantially open circuit at the 4^{th} harmonic, and

(iv) a substantially capacitive impedance load at the remaining harmonic overtones, up to an N^{th} harmonic,

where $N \geq 4$.

16. The amplifier of claim 1, wherein the network is configured to present to the switching component, at all harmonic frequencies substantially present in at least one of the voltage and current waveforms of the active device

(i) a substantially inductive load at each fundamental frequency;

(ii) a substantially short circuit at the 3^{rd} harmonic,

(iii) a substantially open circuit at the 2^{nd} and 4^{th} harmonics, and

(iv) a substantially capacitive impedance load at the remaining harmonic overtones, up to an N^{th} harmonic,

where $N \geq 5$.

17. The amplifier of claim 1, wherein the network is configured to present to the switching component, at all harmonic frequencies substantially present in at least one of the voltage and current waveforms of the active device

(i) a substantially inductive load at each fundamental frequency;

(ii) a substantially short circuit at all odd harmonic overtones up to an Nth harmonic,

(iii) a substantially capacitive impedance load at the remaining harmonic overtones, up to an Nth harmonic,

where $N \geq 5$.

18. The amplifier of claim 1, wherein the network is configured to present to the switching component, at all harmonic frequencies substantially present in at least one of the voltage and current waveforms of the active device

(i) a substantially inductive load at each fundamental frequency;

(ii) a substantially short circuit at all odd harmonic overtones up to an N^{th} harmonic,

(iii) a substantially open circuit at a predetermined number, N_E, of even harmonic overtones for each fundamental frequency up to an N^{th} harmonic,

(iv) a substantially capacitive impedance load at the remaining harmonic overtones, up to an N^{th} harmonic,

where $N \geq 5$ and $0 < N_E \leq (N-2)/2$.

19. A quasi-class E/F_3 high efficiency amplifier for amplifying an input signal having at least one fundamental frequency and adapted to drive a load, comprising:

(a) a high-speed active device that includes

a switching component that operates substantially as a switch and

a parasitic capacitance, C_{out}, in parallel with the switching component and

(b) an LC parallel tank circuit that is resonant at the second harmonic of the fundamental frequency,

the active device being connected in series to the load through the LC parallel tank circuit.

20. A method of amplifying an RF signal with a high speed active device a that includes a switching component that operates substantially as a switch and a parasitic capacitance, C_{out}, in parallel with the switching component, comprising:

amplifying the signal with a high speed active device;

tuning the amplified signal to provide a substantially inductive load to the active device at the fundamental frequency;

tuning the amplified signal to provide a substantially open circuit to the active device at selected even harmonic overtones;

tuning the amplified signal to provide a substantially short circuit to the active device at selected odd harmonic overtones; and

providing substantially capacitive loading to the active device for the non-selected harmonic overtones.